

Environmental neonatology

Nowadays, the small or sick newborn baby is subjected to more intrusive and vigorous investigations and treatment than ever before in neonatal care.¹ The impressive fall in neonatal mortality of very low birthweight infants in the past decade has been welcomed. Concern has been expressed, however, that the development and application of new medical technology have outpaced considerations for the psychological well-being of the very young patient in hospital.²

Crucial questions

Environmental neonatology is a multidisciplinary field concerned with the systematic study of special care facilities for the newborn and their impact on the medical and developmental state of sick infants.^{3,4} The crucial questions are: what is the environment of the special care baby unit like today; and how can we best provide for the bio-behavioural well-being of the preterm infant?

Noise pollution

British safety standards require that the mean noise levels inside an incubator should not exceed 60 decibels. Particular life support equipment, however, and notably, the incubator alarm buzzer, occasionally exceed these limits (up to 85 decibels).⁵ The risk of hearing loss in infants in the absence of other severe neonatal complications is negligible.⁶ In contrast, sudden loud sounds often lead to adverse physiological effects in the newborn. These include sleep disturbance, motor arousal and crying, hypoxaemia, tachycardia, and increased intracranial pressure.⁷ The latter may contribute to the development of intraventricular haemorrhage due to the poor autoregulation of the baby's haemodynamic state, and inadequate cerebral bloodflow in preterm infants.⁸ Particularly loud impulse sounds are caused by the closing of incubator doors (up to 115 decibels sound pressure level), knocking or striking the isolette, or by placing bowls on the incubator.⁴ Noise pollution is mainly caused by staff, and by inconsiderate placement of sound sources—for example, the telephone.⁷ Low frequency sounds of less than 500 Hz are most likely to penetrate the incubator, masking the human voice and speech.⁹ It is difficult to locate a sound source from the enclosure of the incubator, and the infant is prevented from learning

the integration of a particular sound—for example, a voice—with a particular face—for example, the mother. The infant has no control over noise exposure.

Ambient light exposure

The intensity of light in the hospital neonatal intensive care unit has increased five to tenfold in the past two decades.¹⁰ Light intensity is about 60–90 footcandles¹⁰ or 200 lumen/m².¹¹ Considerably brighter light comes from sources such as heat or phototherapy lamps, or sunlight. Infants in special care baby units are often exposed to such intensity for 24 hours a day. Surprisingly, little is known about the effects of light exposure on the small infant. 'Normal' neonatal intensive care unit light, however, may damage the retinas of extremely low birthweight babies.¹⁰

Handling

On average, preterm neonates in special care baby units are handled 130 times every 24 hours.¹² The rest periods between handling are only 4.6 to 19.2 minutes. The main 'disturbers' are the nursing and support staff, then the paediatrician, and lastly, the parents. Handling has been found most consistently to cause disruption of infant's sleep patterns¹³ and to lead to a higher incidence of hypoxaemia, bradycardia, apnoea, and behavioural distress.⁴ A recent study reported that 83% of all incidences of hypoxaemia, 93% of bradycardias, and 38% of apnoeas, had occurred during or immediately after routine handling of preterm infants.¹⁴ The most uncomfortable procedures are routine endotracheal suction and chest physiotherapy. Parental handling is mostly benign and usually consists of gentle stroking and talking which helps babies to settle or maintain deep sleep.¹⁴

Daily rhythms and deep sleep

In most intensive care units there is no clear pronounced diurnal rhythm in noise and light intensity and staff activities.¹⁵ This lack of day and night cycles may be responsible for delayed onset of periodicities and sleeping problems in preterm infants.¹⁶ The introduction of reduced noise, light, and handling at night in neonatal intensive care units

seems beneficial. Infants spent longer sleeping, less time feeding, and they gained more weight after being discharged home.¹¹

High light and noise intensity and frequent handling not only lead to the disturbance of the infant's rest but also increase the time the preterm baby spends in rapid eye movement (REM) sleep. Lower tissue oxygenation, increased chest wall instability, and periodic breathing with the occurrence of five to 14 times more apnoeic episodes during REM sleep in comparison with deep non-REM sleep have been reported.¹⁷

Early learning

The term 'infancy' derives from the Latin 'infans' which means 'speechless'. Young infants have no verbal language apart from crying, and learn through sensorimotor experiences and by making associations with stimuli.¹⁸ Sensorimotor experiences are exposures to tactile and kinaesthetic, auditory, visual, motor, and vestibular information. The description of the current special care baby unit environment shows that there is little opportunity or support for early learning. Indeed, many of the sensorimotor experiences are unpleasant. Furthermore, fewer nurses have to look after more patients in postintensive care rooms. While the preterm infant's capacities for social interaction increase during incubation, vocal and visual stimulation from the nursing staff seem not to change, and are restricted to brief and functional routine contacts (MJ Tanke *et al*, abstract presented at 4th International Conference on Infant Studies, New York, April 1984). Knowledge of the long term effects of the environment of the special care baby unit on the infant is still limited. The observed problems in social interaction in preterm infants after discharge are likely to be consequences of the complex interactions of neonatal medical problems and the special care baby unit environment.¹⁹

Implications for neonatal care

The reviewed evidence suggests that the preterm baby is not under or overstimulated, but inadequately stimulated while in hospital. The premature neonate is neither similar to the fetus nor to a deficient full term infant, but is a unique organism—a medical artefact with special needs.⁴ There is no universal easy recipe for optimal psychological care, but there is a universal principle: individual care. This can be achieved as follows. Firstly, observe the baby before, during, and after procedures; how does he or she react? Secondly, design an individual plan of care to reduce stress and pain, and be supportive of the infant's own behaviour regulation; and thirdly, grow up with the patient. Care plans should

adapt to developmental changes in infants' abilities.

Specific beneficial changes in the environment of the special care baby unit are reduction of noise and light intensity—for example, flexible lighting—reduced and more effective timing of procedures requiring handling, introduction of day and night differences, stroking, containment of motor activity after painful procedures, and sensitive social interaction with the more robust preterm infant.⁴

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